Catalysis in Industry 2016 vol.8 N1, pages 48-55

Effect of the design of a feedstock injection device in a fluidized-bed reactor on the efficiency of the reaction using the dehydrogenation of iso-paraffins in a fluidized chromia–alumina catalyst bed as an example

Solov'ev S., Egorov A., Lamberov A., Egorova S., Kataev A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016, Pleiades Publishing, Ltd.Mathematical modeling is performed for the operation of two units of industrial chemical fluidized-bed reactors with different gas feedstock injection devices, i.e, three toroidal rings with nozzles in unit 1 and a false bottom with nozzles distributed over it in unit 2. Efficiency is analyzed (using the target product (iso-butylene) yield) for the operation of the two units over 4 months under industrial conditions and revealed the higher efficiency of unit 2. To dedetrmine the reasons for different product yields in the two units, a numerical solution is found by mathematical modeling to obtain characteristic pictures of catalyst particle concentrations and temperature fields in these units. It is concluded that unit 2 is characterized by a more uniform and dense distribution of the catalyst along with more uniform heating of the reactor. Pictures of the principal catalyst circulation flows are plotted to explain the considerable difference between the catalyst concentrations and gas temperature fields. Based on the numerical solution, the operational efficiency of the two units is subjected to comparative analysis, which showed good agreement with the results from an analysis of industrial reactors. The approach used in this work could be used in designing new units and optimizing existing units.

http://dx.doi.org/10.1134/S207005041601013X

Keywords

dehydrogenation of iso-paraffins, fluidized bed, industrial reactor, mathematical model, numerical solution